Hemodynamic Monitoring:
The Trauma Patient

Clinical Profile:

Trauma (traw´mă) [Gr. trauma, wound]. 1. A physical injury or wound caused by external force or violence. 2. An emotional or psychological shock that may produce disordered feelings or behavior.[1]

Traumatized patients with bodily injury or illness require expedient, thorough and advanced critical healthcare. Essential, therefore, is the vital accuracy in hemodynamic measurement of preload to optimize cardiac output and oxygen delivery.[2] Such assessment has historically been performed using filling pressures [central venous pressure **(CVP)** and pulmonary artery wedge pressure **(PAWP)**], due to an assumed correlation with end diastolic volume.[3] A new generation of volumetric measurements, right ventricular ejection fraction **(RVEF)** and right ventricular end diastolic volume **(RVEDV)**, however, offers another method of assessment, which is evaluated herein.

Correlations:

- **Correlation #1: RVEDVI and SI / CI**
  Following volume administration over 30 minutes, changes in **SI** have been shown not to correlate with **RAP** or **PAWP** but did correlate with **RVEDVI**. In patients with **RVEDVI** greater than 140 ml/m^2, the fluid challenge increased **RAP** and **PAWP**, and decreased **LVSWI**.[4] Discrepancies between **PAWP** and **RVEDVI** occurred in more than 50% of patients studied and demonstrated that **RVEDVI** more accurately predicted preload recruitable increases in **CO**.[2] In a study conducted by Karen Safcsak, R.N., et al., it was surmised that the **RVEDVI** (rather than pulmonary artery occlusion pressure **[PAOP])** better correlates with **CI** in assessing the ventricular preload of surgical, trauma, post shock volume-resuscitated and respiratory failure patients, making **RVEDVI** "the new gold standard in the assessment of ventricular preload".[5] Studies have confirmed the superiority of **RVEDVI** over **RAP** as an indicator of **RV** preload.[6]

- **Correlation #2: RVEF and trauma survival**
  In trauma patients, survival has been shown to depend upon right ventricular function. In a study of 17 trauma patients, patients demonstrated a decrease in **RVEF**. In survivors, **RVEF** improved over 8-12 hours; in non-survivors, **RV** function continued to deteriorate.[7]

- **Correlation #3: RVEDVI and trauma survival, intestinal perfusion and resuscitation**
  The results of a resuscitation study by Dr. Michael Cheatham, et al., demonstrated that optimal oxygen delivery and tissue perfusion, regardless of ventricular function, is a more individualized (per patient) method for resuscitation, than utilizing **RVEDVI**, **CVP**, or **PAOP** measurements alone for volume resuscitation.[9] Trauma patients resuscitated to an **RVEDVI** of 120 ml/m^2 have significantly better visceral perfusion than those patients resuscitated to 90 to 100 ml/m^2 with inotropic augmentation of blood pressure as needed.[8]

  A study by Dr. Chang, et al., showed that **RVEDVI of >100ml/m^2 = ↑ intestinal perfusion, ↓ mortality, ↓ MOF.** [10]

Outcome:

It has been recognized that a new catheter, combining **SvO_2** with **RVEF, RVEDV** measurements and continuous thermodilution cardiac output **(CTCO)**, will yield not only information regarding oxygen consumption and delivery, but will also permit a better understanding of hemodynamics. Loren D. Nelson, M.D. concluded in his report that the combination of intravascular pressure measurements and continuous cardiac output **(CCO)** also allows calculation of left ventricular **(LV)** and right ventricular **(RV)** stroke work that, “under conditions of steady state preload and afterload, reflect the contractile function of the heart as a determinant of cardiac performance.” On a near continuous basis, the critical care team will thus be provided with complete hemodynamics and oxygen transport values.[3]

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